A Steerable Distance Enhanced Penetrometer Delivery System

Developer: UTD, Inc.
Contract Number: DE-AR21-94MC31178
Crosscutting Area: CMST

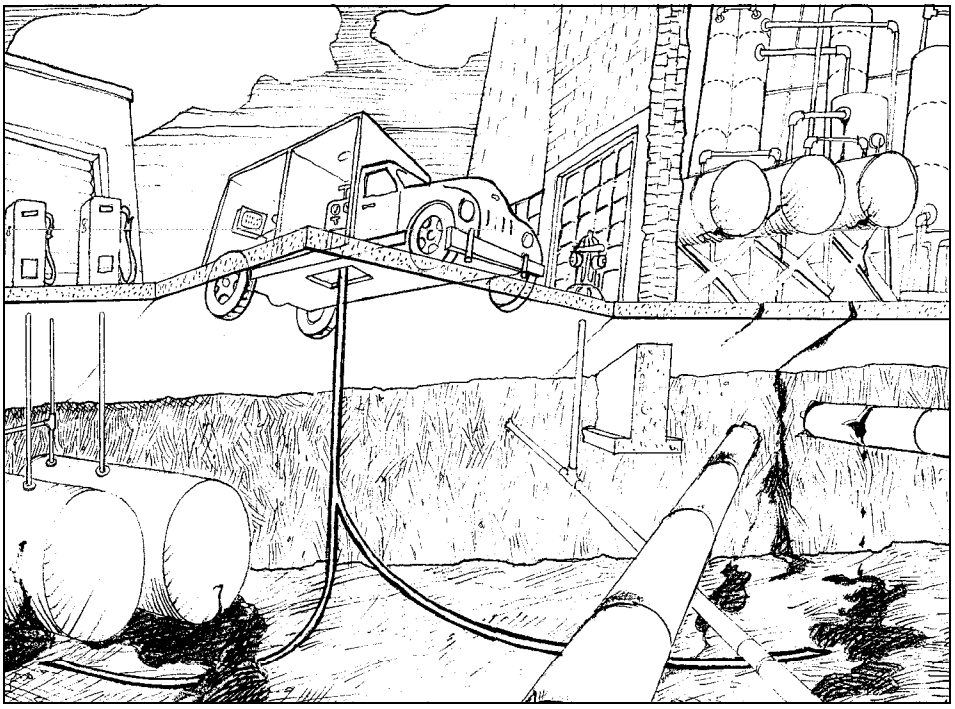
Subsurface Contaminants FOCUS AREA

Problem:

POLO, a unique real-time, in situ position location determination device for use on penetrometers has been developed and demonstrated under Department of Energy (DOE) sponsorship. The advantage provided by POLO is that the operator now has the capability to know the exact position of his sampling locations. The basic problem of the inability to direct penetrometers to specific locations and penetrate through stiff geologic materials still looms, while the need to characterize beneath buildings and other structures can still only be done at great expense.

Solution:

A result of POLO's successful development is the emergence of new opportunities to make major advances in characterization and remediation. Specifically, penetrometers armed with POLO for position location, can now be enhanced further to perform directional penetration to points of interest. A whole new generation of penetrometer delivery systems capable of both steerable penetration and improved penetrability by vibratory means can now be developed on the basis that the POsition-LOcation aspect of the development is essentially solved.



Benefits:

A steerable and vibratory enhanced penetrometer delivery system for characterization sensors will provide:

- Directional control of penetrometers to specific points of interest beneath or adjacent to structures, underground obstacles, and magnetic material.
- Improved distance capability by vibratory thrusting of the penetrometer system.
- A reduction in the hazard associated with accidental puncture of underground storage tanks.

Technology:

With the advent of POLO, which provides position location for penetrometers on a point by point basis through measurement of rod bending and distance traveled into the borehole, the use of penetrometers as a steerable tool becomes feasible. This project

focused on technology development to provide steering capability through mechanical systems at the tip of the penetrometer rod and through control of the orientation of the tip mechanism. Since a steerable penetrometer is only successful if the rod does not break during bending, POLO was also used to monitor bending to allow operators to stay within the bend limit of their system. Bends along the length of the rod during steering to a specific underground location also reduce the effectiveness of the available thrusting force to attain reasonable distances of penetration. Integration of a vibratory thrusting system and POLO was also key to this project.

Project Conclusion:

The project was concluded in August 1997. The final task for this contract was the field demonstration of the steerable vibratory system (SVS). The SVS was demonstrated at a site in Delmar, Maryland on August 7, 1997. Successful demonstration of the SVS proved the feasibility of placing sensors at specific locations underground. The tests conducted with the field deployable SVS showed that path curvatures of 70 to 150 feet can be generated depending on soil conditions. This would allow the possibility of characterizing soils or placing sensors under buildings and storage tanks. In the demonstration test, the SVS tip was steered to within 28 inches of a target which was selected by the audience before the test started. The target was at a depth of 71 feet with a lateral deviation of 11 feet from the point of rod insertion. This was the first time that controlled steering with the penetrometer technology was demonstrated. Previous tests at depths of 71 feet had a position error of less than 0.5 percent.

The SVS demonstration test showed that the SVS technology is field deployable. The next step in making the technology available to end users is product commercialization. This involves upgrading of the vibratory rig for more enhanced penetrability, system automation and development of user guides and instructional media.

Contacts:

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